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Changing the dialogue between science and its publics: the case of the 'Hydrogen Economy'

Miriam Ricci, Rob Flynn and Paul Bellaby

Institute for Social, Cultural and Policy Research

Humphrey Booth House M5 4WT University of Salford

m.ricci@salford.ac.uk

r.flynn@salford.ac.uk

p.bellaby@salford.ac.uk

Remarkable changes are affecting the ways in which science, and more broadly scientific and technological development and innovation, are funded, governed, and evaluated.

They include changes in the relationship between science and its publics, starting with recognition that there are indeed various 'publics', not merely 'the public'. In recent years also, several commentators have championed a new model of promoting public engagement in technological innovation, which departs radically from the traditional 'deficit model' of public understanding of scientific and technological advancements.

In the UK, for instance, the Office of Science and Technology, in partnership with the Wellcome Trust, produced a report (OST-Wellcome Trust, 2001) in which the notion of 'public understanding of science' was reviewed to reflect the shift to a more inclusive, less patronising model of science communication. The convention had been to educate 'the public' and give them the facts about scientific advancements, in a unidirectional flow of information from experts to lay people. This model, commonly referred to as the 'deficit model', has been criticised for 'framing' judgements of what is relevant for enquiry in a hidden consensus among scientists and policy-makers that is often value-laden, and for failing to establish real communication (two-way dialogue) between publics and those who support and produce new scientific knowledge and technologies.

The increasing amount of social research that addresses public perceptions and understanding of various technological issues (Radioactive Waste Management, Genetically-Modified Organisms, Nanotechnology, etc.) has led to a more sophisticated concept of 'the public' which recognises the variety, complexity and dynamic nature of public views and concerns. Irwin (1995) has introduced the concept of 'scientific citizenship' to emphasise the role that public values and concerns about technological developments could play in policy making and risk assessments. He recognises that conventional representations of 'the public' neglect the fact that there are different types of 'publics' with distinctive understandings of scientific issues – a fact which calls for a more flexible and differentiated way of communicating and engaging with citizens. Irwin (1995) has also stressed how different, yet valuable and legitimate, is the expertise that publics may possess, and the need to allow it to interact constructively with more institutionalised forms of technical and scientific expertise. This is particularly important in situations where 'facts' do not simply speak for themselves and scientific knowledge and assumptions are contested, inconclusive and uncertain. In such situations, questions can be raised regarding the type of information that is fed to the public, who controls it and how to account for uncertainties and unknowns.

Although a shift towards a more genuine form of engagement with publics in scientific and technological development is already taking place, there are still areas that require further attention. By drawing upon empirical evidence concerning public attitudes to GM organisms in the UK, Grove-White *et al.* (2000) give important insights on issues related to the development of new technologies in general. Technological advances and novelties are framed in substantially different ways by informed stakeholders or experts on the one side and lay publics on the other side. Technical and economic assessments of benefits, costs and risks associated with new technologies often fail to address wider concerns that emerge in public debate. Particularly relevant are concerns about the motivations that underlie the development of new technologies, the actors who control the content and direction of technological change, and the liability and responsibility of these actors when there are unexpected consequences or unknown effects.

Findings from the work of Grove-White and his associates suggest that, in some cases, people may actually become more reluctant to support new technologies after receiving more information, and that, when areas of unclear or contested knowledge are deliberately occluded to the public, this may increase public unease with new technologies, for trust in the actors involved in technological developments may be as important as factual evidence in shaping public reactions.

Efforts have been made to develop more inclusive and deliberative forms of decision-making about technological issues, capable of assessing and incorporating public perceptions and attitudes (Wilsdon and Willis, 2004) from the early stages of the innovation process. An example is *GM Nation?* – a public debate which took place during the summer of 2003 in the UK. This unprecedented experiment in public participation in science and technology constituted a significant step in public engagement. It has been criticised for a number of shortcomings, including having taken place too late in the development of GM technologies to cause significant changes in the direction of GM research, with the result that progress in biotechnology was impeded (Horlick-Jones *et al.*, 2004).

This paper illustrates a case where new approaches encouraging an ‘interactive understanding’ between science and its publics are particularly relevant. The case we examine in this paper is about the future of energy, and in particular the development of the so-called ‘Hydrogen economy’, in which a range of alternative, but potentially radically innovatory socio-technical systems based on hydrogen energy, is being advocated as a means of dealing with problems such as climate change and over-dependence on fossil fuels. Hydrogen as an energy carrier is being promoted for use in transport and in portable and stationary applications. It is frequently described as ‘environmentally-friendly’, and capable of being generated through renewable sources. However, it is an emergent technology in which there are, as yet, few demonstrable consumer applications and very little public awareness, and in which scientific innovation is being projected into future scenarios requiring large-scale societal change whose feasibility (and desirability) remains problematic.

Engaging with the public in a context characterised by still unresolved technical questions and widespread lack of knowledge among lay people is fraught with challenges.

Firstly, the technical nature of the subject is complex and has major uncertainties. Hydrogen energy is at a very early stage of development and might be used in any one of many different future technological configurations. As an energy vector, hydrogen must be produced by consuming a primary source of energy, and some of the options are non-renewable and produce emissions. The multiplicity of production routes, the level of centralisation in production and use, the diversity of storage technologies and distribution

infrastructures, and the myriad potential end-uses all combine to increase the complexity and uncertainty associated with this technology.

Publics encounter applications of technology such as a means of transport, rather than the science and engineering that lie behind them. Hydrogen energy can be embedded in radically different applications, which involve distinctive patterns of consumption and different interactions with society. The degree of uncertainty about the future deployment and diffusion of hydrogen energy across society is great. Expert accounts are not unanimous in this respect. For instance, some hydrogen-based technologies are nearer to commercialisation than others and economic modelling of the various alternative scenarios remains speculative.

Secondly, evidence from recent studies suggests that public knowledge and awareness of new developments in hydrogen technologies are significantly low. As argued by Shackley *et al.* (2004, in reference to carbon storage and sequestration technology, major difficulties arise when presenting (and encouraging public debate about) complex technical issues which are remote from people's everyday experience and for which people have no immediate reference points.

Only a few studies addressing public understanding of hydrogen energy are available (for a detailed review, see Ricci, 2006). Most of them are survey-based and make no attempt to actively engage the public in an informed debate addressing broader questions around future energy options. The focus tends to be public risk perception of a handful of hydrogen applications, such as prototype buses running in several cities around the world (among them, London). We have attempted to overcome these limitations by taking a 'whole systems approach' and considering hydrogen energy as the core of a complex 'socio-technical system' (Bijker *et al.*, 1987), consisting of tangible technological artefacts and less tangible social, political, organisational and cultural components. The context in which we have chosen to frame and discuss hydrogen energy is not limited to risk perception of a few applications; rather, it encompasses questions about energy provision and use, global changes affecting the environment and ways to mitigate these, future energy options including but also beyond a hydrogen economy, issues of public trust in different institutions and organisations, and ways of engaging with the public.

The paper presents and discusses preliminary results, based on qualitative data from focus groups and interviews from our ongoing project¹ investigating laypeople's and stakeholders' views about a possible hydrogen economy and, more generally, different energy futures. We have carried out focus groups with a cross-section of the public in three regions of the UK where hydrogen energy developments are being planned or already operational at prototype level (Teesside, South Wales and London). During the meetings, people were able to discuss hydrogen in the broader context of energy and the environment. They were presented with visual material to aid discussion and were able to ask questions and receive explanations about technical issues.

Preliminary findings from the groups indicate that public perceptions of hydrogen are neither wholly positive nor wholly negative. They are always conditional and contextual. Perceptions of hydrogen as an energy carrier are always framed and expressed within a wider system of beliefs and values about other energy sources and technologies, and about broader environmental issues. Most participants expressed their concerns about the implications of using fossil fuels use in terms of global changes in the climate and the eventual exhaustion of what are finite supplies. Some people were in favour of increased

¹ EPSRC-funded UK Sustainable Hydrogen Energy Consortium, www.uk-shec.org

use of renewable sources and greater diffusion of energy efficient technologies and of recycling.

Concerns about hazards and risks to safety and the environment were evident, but these did not surface as major sources of objection or outright opposition to the development of hydrogen technologies. There was a recurrent belief that government and industry would carry out risk assessments and engineer proper safety systems before the introduction of the technologies.

Focus groups all agreed that individuals' behaviour (as consumers) would be influenced by the interaction of, and 'trade-offs' between, cost, safety, 'useability', and environmental benefits. People expressed the need for detailed and reliable impartial information about this, and asked cogent questions about how environmental benefits of hydrogen would compare with other technologies, how they would be distributed and who would be responsible.

Members of the public showed very strong interest in seeing practical examples of hydrogen technologies in action, and indicated that public acceptance would largely depend on seeing demonstration projects and *real* applications in use.

People seemed in general distrustful of governments' willingness and commitment in tackling energy and environmental issues. Distrust of industry emerged as well, although this varied across different geographical contexts. Ambivalent attitudes emerged, depending on participants' direct or indirect experience (as residents, workers, etc.) of local industries, such as chemicals, steel making, coal mining and nuclear.

Most participants welcomed the idea of public engagement in such issues as energy futures and technological options, and expressed support for increased use of public consultation, although they recognised that governments would have to make decisions.

Our work aims to make a significant contribution to the debate about public engagement in science and technology. This is an emerging field that requires the development of adequate processes and techniques in order to overcome the limitations that exploratory research studies have uncovered. In particular, the shift towards greater engagement with the public (as opposed to simple information provision and one-way communication) poses significant challenges: since two-way engagement is more intensive, it is more difficult to be representative of wider populations when sampling for groups and it also requires considerable resources.

Future public engagement processes need to have clear objectives from the start. The public should know how their views would be taken account of in policy- making. This could lead to more robust decisions and strengthen public trust in the actors that govern scientific and technological development (Wilsdon and Willis, 2004).

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